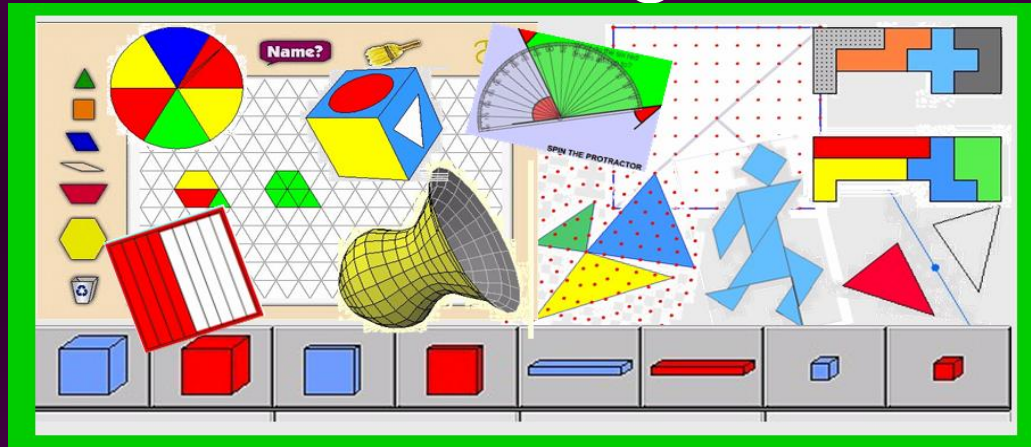


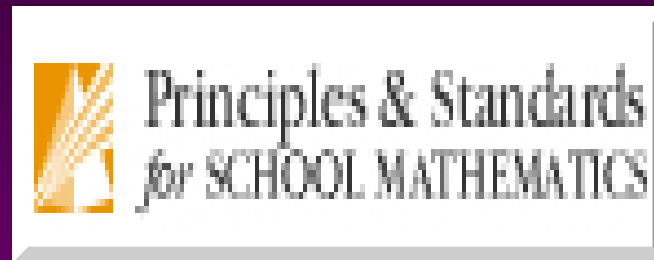
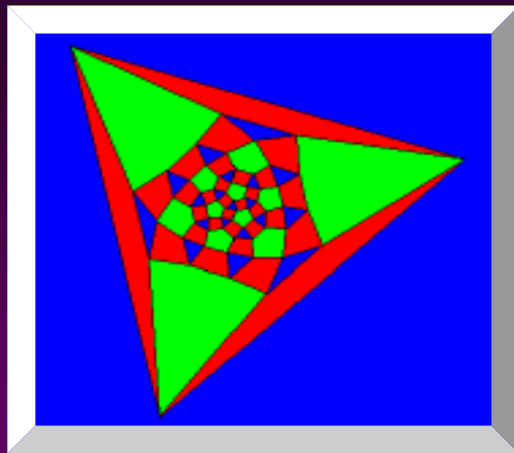
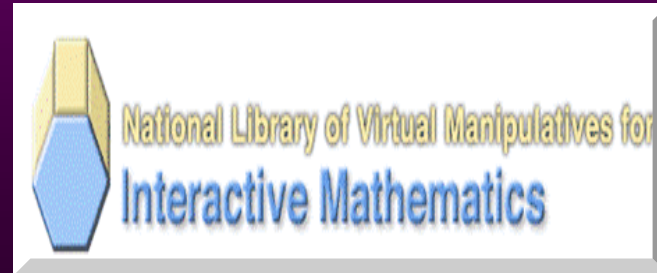
Virtual Manipulatives: What Does Current Research Tell Us About Classroom Practice and Student Progress



Jeanine Haistings
University of Kansas
William Jewell College
haistingsj@william.jewell.edu

- Virtual manipulatives have been described as computer versions of physical manipulatives.
- One of the defining characteristics is that the user controls the actions with a mouse or keypad.

A Sample of Virtual Manipulatives



Moyer, Neizgoda, Stanley

2005

- Young Children's Use of Virtual Manipulatives and Other Forms of Mathematical Representations.
- In 2005 NCTM Yearbook Titled: Technology-Supported Mathematics Learning Environments
- Conversation with Moyer 2005

Part I: Kindergarten Title I School

Three day lesson on patterns, focusing on both repeating and growing patterns

Analyzed

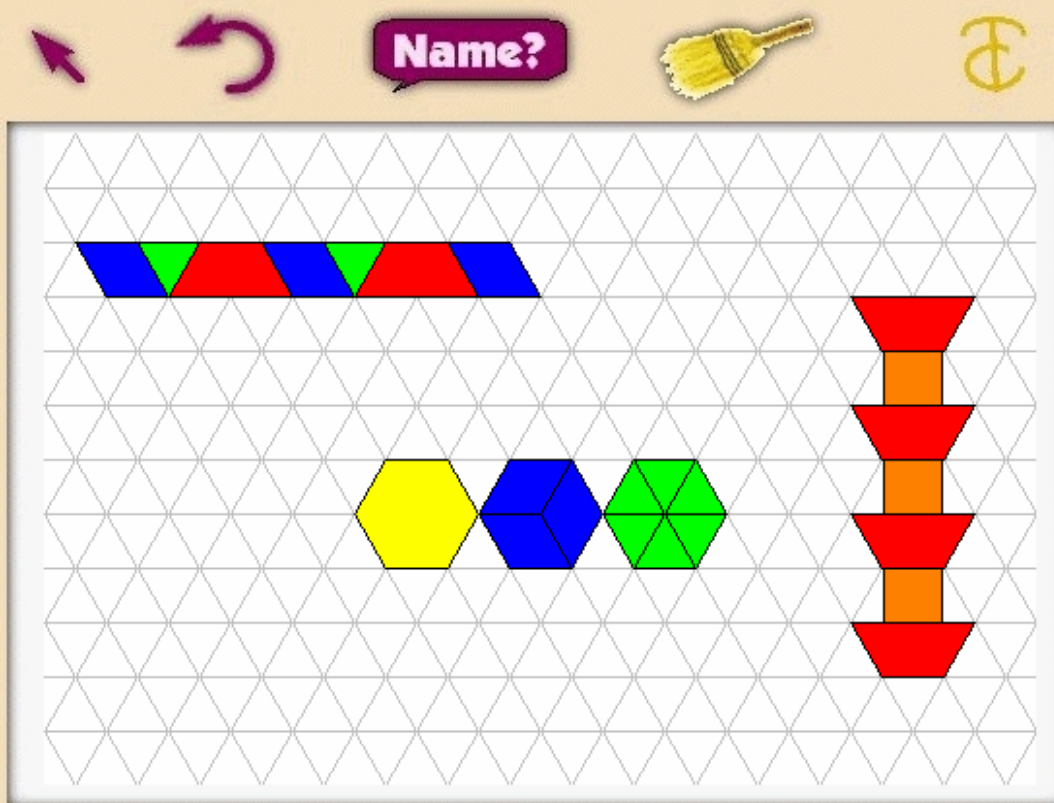
How the form of representation influences the variety and complexity of the patterns

The study

Day 1 – Wooden pattern blocks used

Day 2 – Virtual pattern blocks used

Day 3 – Students created and drew
patterns, free hand on strips of paper



[instructions](#) | [description](#) | [instructions to print out](#)

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Results

From observers (each watching 4-5 students)

1. Children made greater number of patterns using the virtual blocks compared to the other two days
2. Variety of patterns stayed the same among all three representations

Results

3. Complexity of elements was greater with the Virtual Blocks
4. More creative with virtual blocks
5. Using the three different representations gave the students many opportunities to communicate their thinking

Part II: Second Grade regrouping

2 day lesson on addition with regrouping

Analyzed:

If using virtual manipulatives on Day 1 would enhance the children's ability to develop their visual-representation skills

The Study

Day 1 – Students used the virtual base ten blocks and recorded their the sums on paper

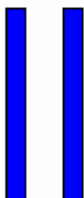
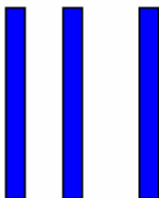
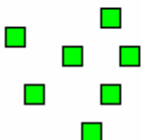
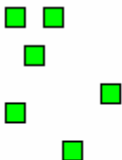
Day 2 – students received four different addition exercises and we asked to draw a solution and provide a written explanation

English



Name?



100	10	1
	 	 

[instructions to use it](#) | [description and lesson plan](#) | [instructions to print out](#)

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Results

1. Both days students completed 80 – 83% of the exercises with 75% accuracy
2. The difference was in the strategies students used in the second day. Students moved from using counting, to using place value concepts.

Jennifer Suh

George Mason University

- Dissertation published Spring 2005
- Third Grades' Mathematics Achievement and Representation Preference Using Virtual and Physical Manipulatives for Adding Fractions and Balancing Equations.

Purpose

Compare students achievement and representational preference when teaching addition of fractions with unlike denominators and balancing linear equations using VM and concrete manipulatives.

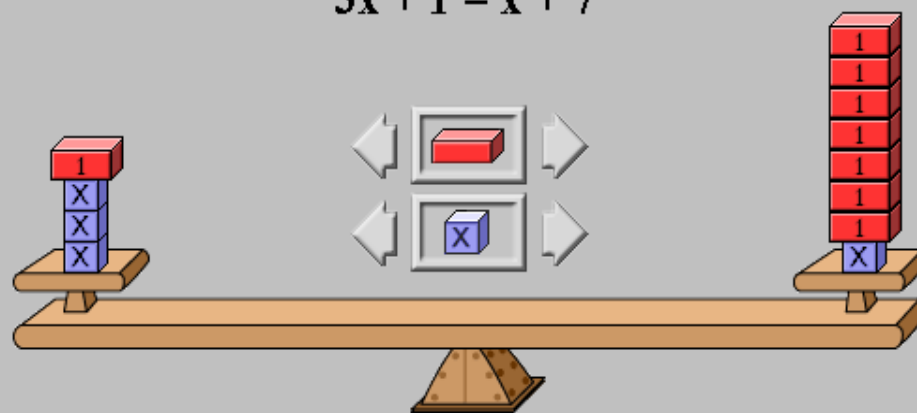
The Study

- Two Third Grades – 36 students total
- Two groups – virtual manipulatives treatment group and physical manipulatives treatment group
- Switching on the second unit
- Within – subjects crossover repeated measures design, both receiving both treatments serving as his or her own comparison

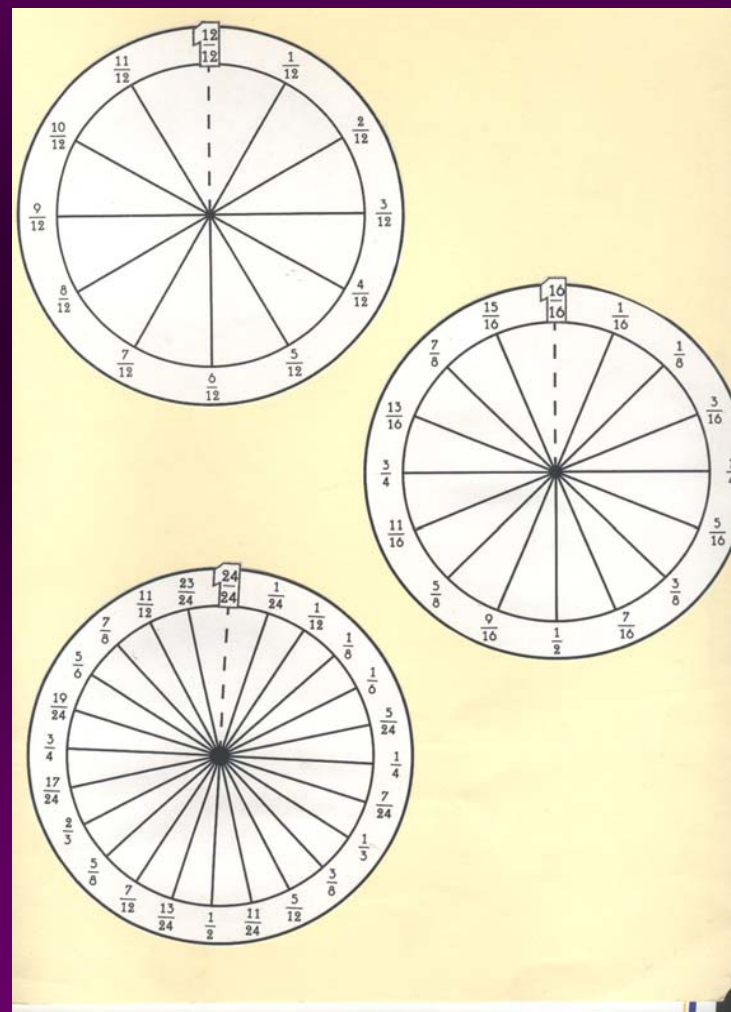
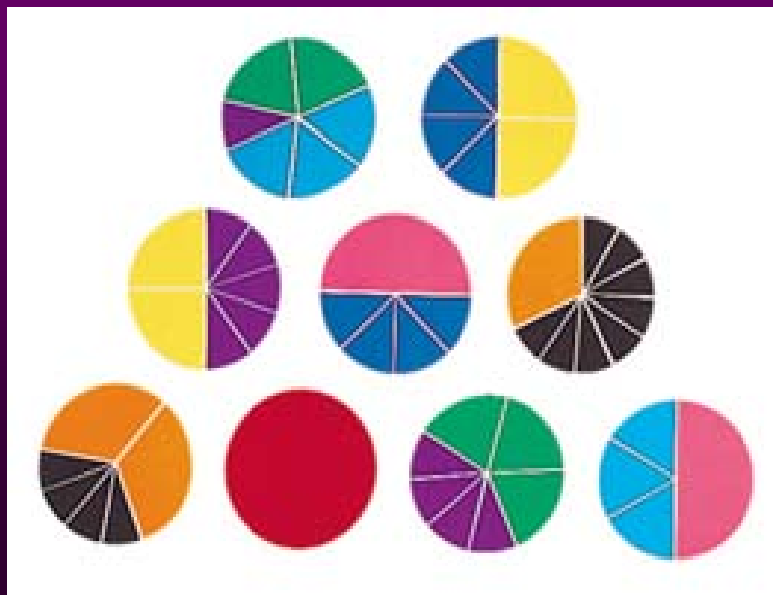


Click arrows to place unit blocks and x-boxes on the pans to represent the equation.

$$3x + 1 = x + 7$$

[Continue](#)[Clear](#)[New Problem](#)







Back



Activities



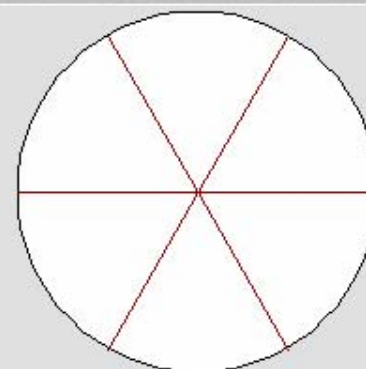
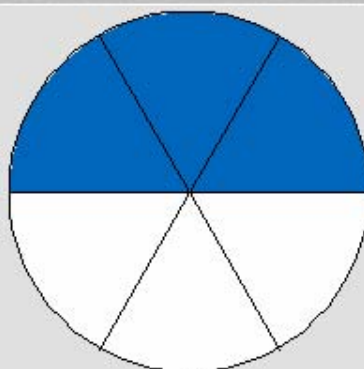
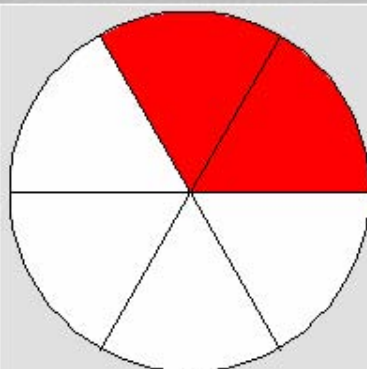
Parent/Teacher



Standards



Instructions



6 pieces

$$\frac{1}{3} + \frac{1}{2} = \frac{2}{6} + \frac{3}{6} = \frac{\boxed{}}{\boxed{}}$$

Now drag the colored regions into the sum circle and name the sum.

Results

Field notes, posttest, video, survey, interviews

1. Virtual manipulative group outperformed students in the physical manipulative.
2. Virtual manipulatives fraction treatment group had scores on the posttest that were **statistically higher** than students who worked with the physical manipulative fraction circles.

Results

3. Virtual manipulative algebra balance scale group had posttest scores that were **not statistically significant** from students who worked on the physical manipulatives, Hands-On Equations®.

Results

4. Virtual manipulative environment provided guidance for learning formal algorithm for adding fractions with unlike denominators, such as:
 - (a) linked representations,
 - (b) step-by-step procedures,
 - (c) immediate feedback systems

Results

5. Students preference was determined by students' learning experiences with the specific applet, manipulative tool and mathematical concept.

Johanna Bolyard

George Mason University

- Dissertation Published in Spring 2005
- A comparison of the impact of two virtual manipulatives on student achievement and conceptual understanding of integer addition and subtraction.

Purpose

- The purpose of this study was to investigate how the use of virtual manipulatives representing two different models for integers, a quantity model and a number line model, impacts student achievement in integer addition and subtraction.

The Study

- Mixed Method
- 6 sixth grade classrooms = 99 students
- Over a four week period

Each class was randomly assigned to one of three virtual manipulatives treatments

- Data was collected from pretest and posttest measures and interviews

*Click the Exploration Guide link to launch a step-by-step activity for this Gizmo.

[EG Exploration Guide](#)

Adding Real Numbers Gizmo

☒ Add two real numbers
 ☐ Add three real numbers

$$6.1 + (-7.8) = -1.7$$

a
 b

Assessment Questions

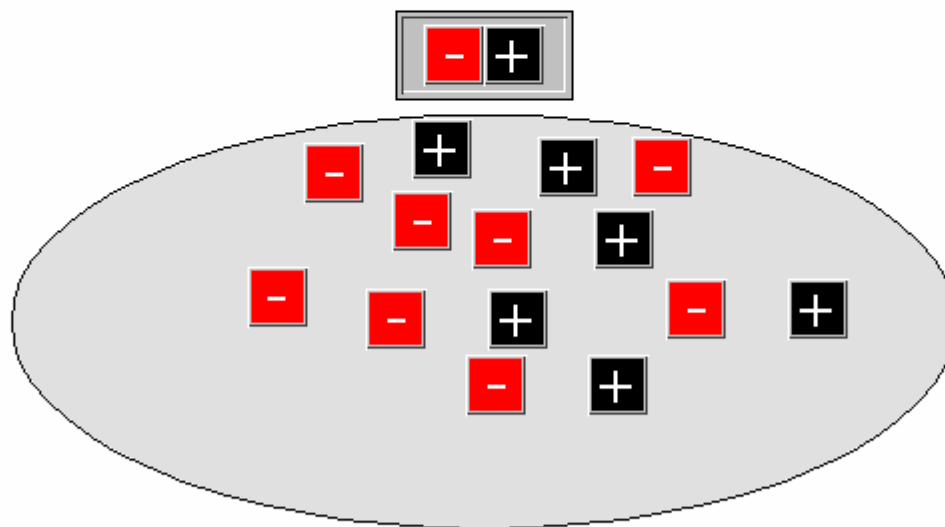
1. What is the final position of $2 + (-1)$ on a number line?



Click and drag enough pairs of +,- chips to the circle so that you can take away 6 plus chips. Then click the Continue button.

$$(-2) - 6$$

Continue



Problems: ☒ Computer ☐ User ☐ Free Play

New Problem

Color Chips Subtraction

Your account shows a debt of \$5. You subtract a \$3 asset. Click and drag chips to the circle to represent your initial balance (\$5 debt). Click "Continue."

$(-5) - 3$

Continue



New Problem

Results

- Overall – student in each group made significant pretest posttest gains on both integer addition and subtraction
- Analysis did not show any differences between the three virtual manipulatives being used

Results

- Qualitative analysis of interviews and student work revealed students were able to work with variety of representational forms.
- Students then went on to use the different representational forms to facilitate, explain, and self-evaluate their own work.

eNLVM

- An Extension of National Library of Virtual Manipulatives
- Interactive Online Learning Units
- Online Assessments
 - students to submit answers they have typed and work they have done using applets.
 - Teachers can view class summaries and individual answers.

UtahState
UNIVERSITY

interactive online math lessons

Introduction to the eNLVM

The eNLVM is an NSF-funded project to extend and enhance the NLVM by developing:



eModules

eModules are interactive online units that target *objectives* identified as important in state and national standards, include *lesson plans*, contain *interactive online activities*, and provide *online assessments*. Each eModule is intended to cover between one and three class periods of instruction.



Tracking Tools

The eNLVM provides functionality that allows students to submit answers they have typed and work they have done using applets. Teachers can view class summaries and individual answers. Answers to some types of questions are automatically checked when an answer key is specified.



Adaptation Tools

Teachers can modify lessons and activities in the eNLVM to tailor them to the needs of

Learn More

- [Explore eNLVM resources](#)
- [Register to begin using the eNLVM](#)
- [View online tutorials](#)
- [Download a Quick Start Manual](#)
- [Read more about the eNLVM project](#)

eNLVM Adaptation Tools Available

- Teachers can modify lessons and activities
- Options for customization include:
 - modifying,
 - creating,
 - reorganizing,
 - deleting activities,
 - instructions,
 - questions,
 - **and applet configurations.**

UtahState
UNIVERSITY

interactive online math lessons

[Home](#) > Browse Available Resources By: Course: **Fraction Concepts** (Math 2, Math 3) (4 x 50 min.)

Students are led to form the concept of fraction as a number that can be used to describe things that are part of a group.

[\[Lesson Plan\]](#) | [\[Discuss\]](#)

Click on a resource to view its contents.

Fraction Concepts - Lesson Plan [\[Show Teaching Plan Only\]](#)

- [Objectives](#)
- [Teaching Plan](#)
- [Assessment](#)
- [Worksheets](#)
- [Credits](#)
- [Correlation to Standards](#)

Objectives

- Describe what a fraction represents and what a numerator and denominator are. (Comprehension and Communication)
- Convert fractions between symbol, sentence, and picture representations. (Comprehension and Communication)
- Give examples of where fractions appear in every day life. (Application)
- Given two fractions with the same denominator, identify which is larger. (Algorithmic; Concept)
- Given pictures of two fractions with different denominators identify which is larger. (Comprehension and Communication)

Teaching Plan

What a fraction describes (40 minutes)

The objective of the first lesson is to understand what a fraction describes.

1. Read the children's book to your class, [Only One \(Harshman, 1993\)](#) and define fractions as numbers that can describe when an object is a part of something larger.



2. Ask a few students to describe how they are a part of a larger family group using a sentence like: "I am one out of a family of ____." Write their answers on the board.



3. Ask students to describe how many members of their family are boys and girls by using sentences like: "____ out of my family of ____ are girls." Write their answers on the board.



4. Go through the eModule section *What a Fraction Describes* with students working individually on computers or as a group using a computer projection system.

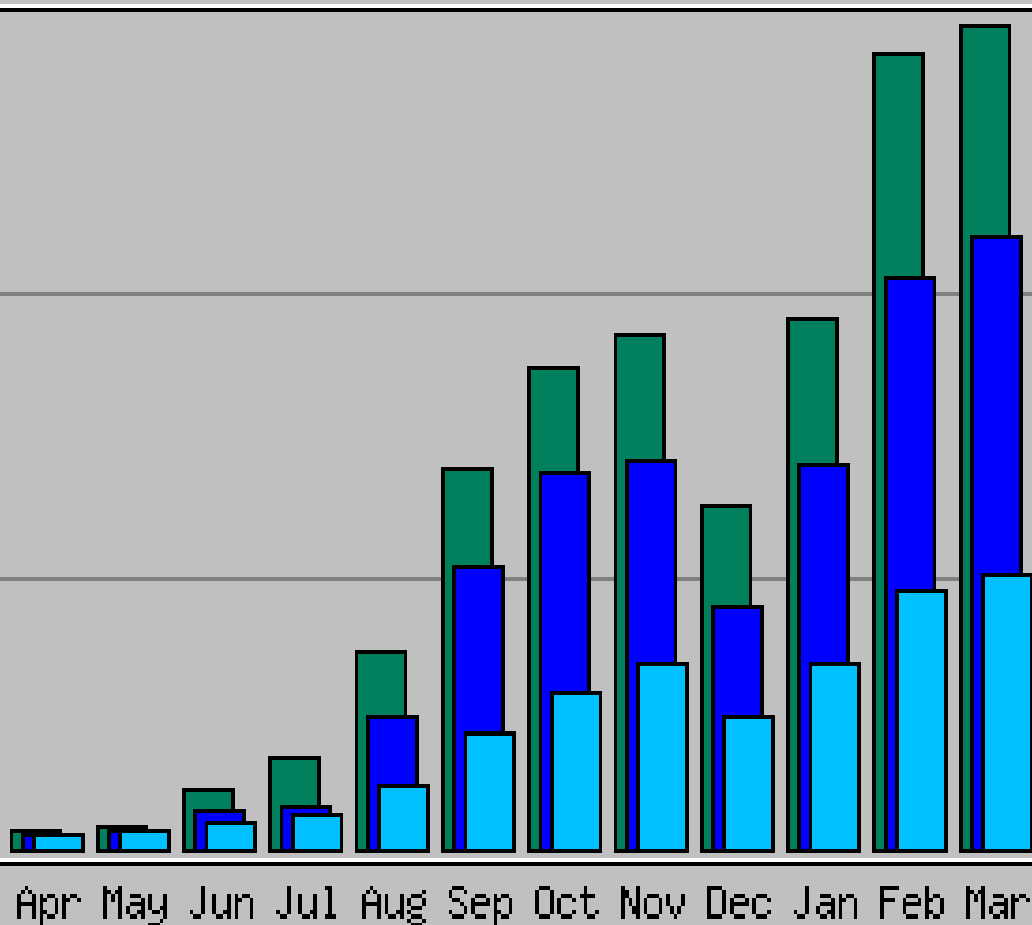
Current Project Information

Joel Duffin, Utah State

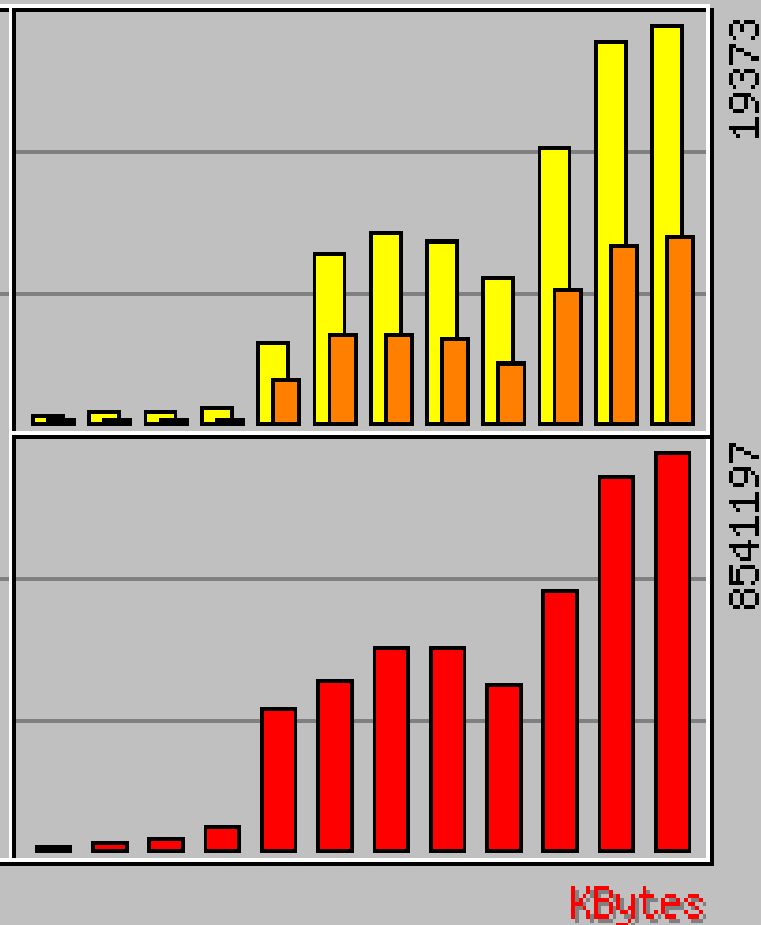
- Over 1500 users (teachers)
- 1100 Schools
- 4,200 students

Usage summary for enlvm.usu.edu

Pages / Files / Hits

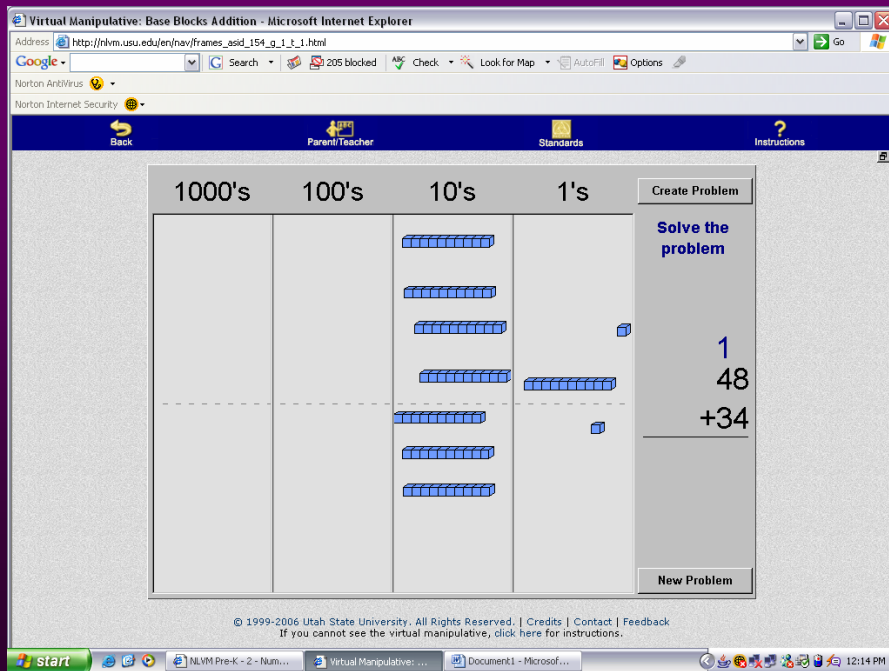


Visits / Sites



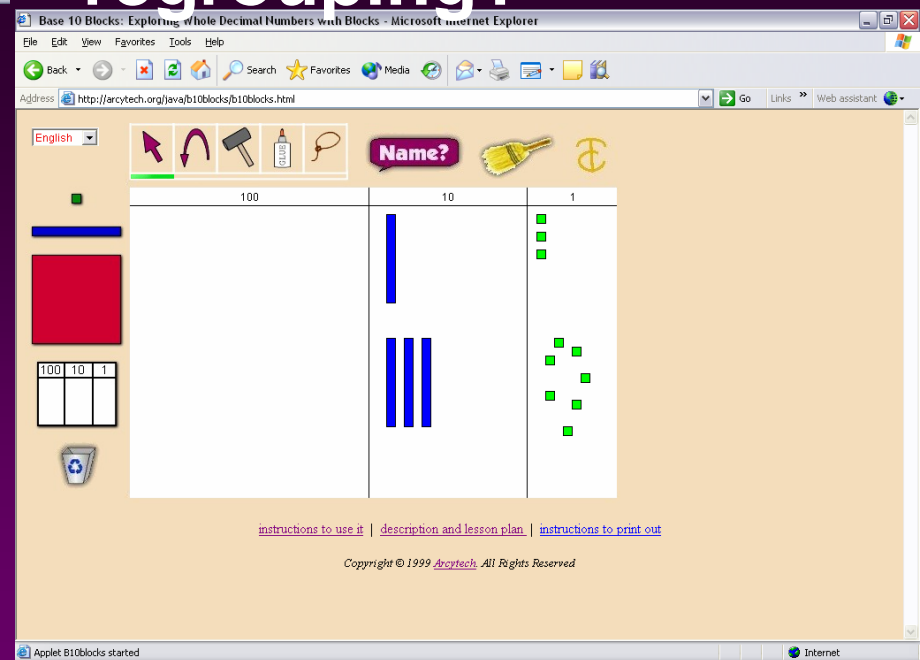
KBytes

What are our next
research questions?



Will feed back in the form of an abstract representation effect student's understanding of addition with regrouping?

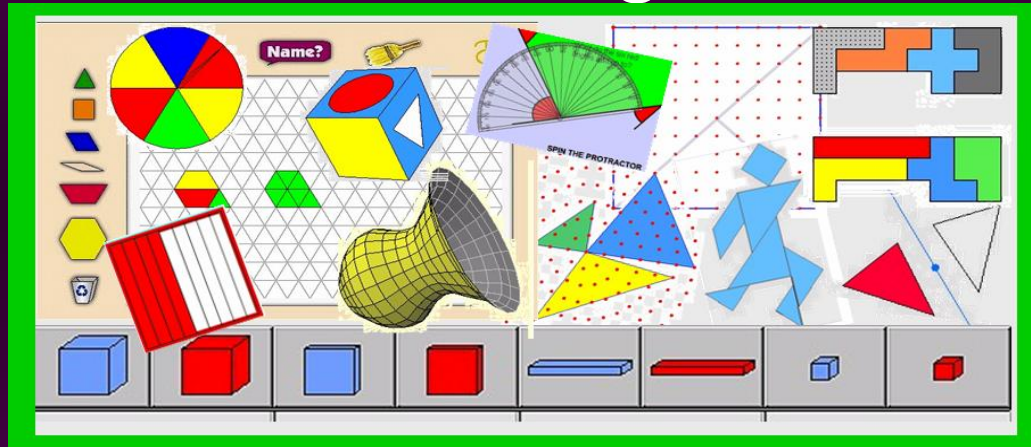
Research to be completed in Spring 2007



Our next challenge

How do we effectively
train teachers?

Virtual Manipulatives: What Does Current Research Tell Us About Classroom Practice and Student Progress.



Jeanine Haistings
University of Kansas
William Jewell College